Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A method of removing empty string terms from an automaton A having a ~~set~~ plurality of states "p", a ~~set~~ plurality of states "q", and a ~~set~~ plurality of outgoing transitions from the ~~set~~ plurality of states "p", E[p], the method comprising:

inputting a plurality of electrical signals representing the automaton A, the automaton A further representing a plurality of hypotheses with associated weights;

computing an ε-closure for each ~~state~~ of the plurality of states "p" of the automaton A;

producing a plurality of electrical signals representing an improved automaton A, the producing comprising modifying E[p] by:

removing each ~~transition~~ of the plurality of transitions labeled with an empty string; and

adding to the plurality of outgoing transitions, E[p], a non-empty-string transition, wherein each ~~state~~ of the plurality of states "q" is left with its weights pre-multiplied by an ε-distance from a corresponding one of the plurality of states ~~state~~ "p" to a respective one of the plurality of states ~~state~~ "q" in the automaton A.

2. (Currently Amended) The method of claim 1, wherein the producing of the plurality of electrical signals representing the improved automaton A further ~~comprising~~ comprises:

removing inaccessible ones of the plurality of the states "p" and "q" using a depth-first search of the automaton A.

3. (Currently Amended) The method of claim 1, wherein adding to the plurality of outgoing transitions, E[p], a non-empty-string ~~transitions~~ transition further comprises leaving each of the plurality of states "q" with weights ($d[p,q] \otimes \rho[q]$) to E[p].

4. (Currently Amended) The method of claim 1, wherein ~~the step of~~ the computing of the ε-closure for each ~~input state~~ of the plurality of states "p" of ~~an~~ the input automaton A further comprises:

removing all transitions not labeled with an empty string from the automaton A to produce an automaton A_ε;

decomposing the automaton A_ε into its strongly connected components; and

computing all-pairs shortest distances in each ~~component~~ of the strongly connected components visited in reverse topological order.

5. (Currently Amended) The method of claim 1, wherein the ~~step of~~ computing <u>of the</u> ε-closure for each ~~input state~~ <u>of the plurality of states "p"</u> of ~~an~~ <u>the</u> input automaton A further comprises:

<u>removing all transitions not labeled with an empty string from the automaton A to produce an automaton A_ε;</u>

decomposing A_ε into its strongly connected components;

performing a single-source shortest-distance algorithm according to the following pseudo code:

for each $p \in Q$

do $d[p] \leftarrow r[p] \leftarrow \bar{0}$

$d[s] \leftarrow r[s] \leftarrow \bar{1}$

$S \leftarrow \{s\}$

while $S \neq 0$

do $q \leftarrow$ head [S]

DEQUEUE (S)

$r \leftarrow r[q]$

$r[q] \leftarrow \bar{0}$

for each $e \in E[q]$

do if $d[n[e]] \neq d[n[e]] \oplus (r \otimes w[e])$

then $d[n[e]] \leftarrow d[n[e]] \oplus (r \otimes w[e])$

$r[n[e]] \leftarrow r[n[e]] \oplus (r \otimes w[e])$

if $n[e] \notin S$

then ENQUEUE (S, n[e])

d[s] ← $\bar{1}$.

6. (Currently Amended) The method of claim 1, wherein the ~~step of~~ the computing of the ε-closure for each of the plurality of states ~~state~~ "p" further comprises computing each of the ~~ε-closure~~ ε-closures according to the following equation:

$$C[p] = \{(q,w) : q \in \varepsilon[p], d[p,q] = w \in K - \{\bar{0}\}\}.$$

7. (Currently Amended) The method of claim 6, ~~wherein the step of modifying outgoing transitions of each state "p"~~ further comprises modifying the outgoing transitions of each of the plurality of states ~~state~~ p according to the following procedure:

~~(1)~~ for each $p \in Q$

~~(2)~~ do $E[p] \leftarrow \{e \in E[p] : i[e] \neq \varepsilon\}$

~~(3)~~ for each $(q,w) \in C[p]$

~~(4)~~ do $E[p] \leftarrow E[p] \cup \{(p,a,w \otimes w',r) : (q, a, w', r) \in E[q], a \neq \varepsilon\}$

~~(5)~~ if $q \in F$

~~(6)~~ then if $p \notin F$

~~(7)~~ then $F \leftarrow F \cup \{p\}$

~~(8)~~ $$\rho[p] \leftarrow p[p] \oplus (\omega \oplus \rho[q]).$$

8. (Currently Amended) The method of claim 7, wherein a state is a final state if ~~some~~ <u>at least one of the plurality of states</u> ~~state~~ "q" within a set of states reachable from <u>one of the plurality of states</u> "p" via a path labeled with an empty string is final and the final weight is then: $\rho[p] = \bigoplus_{q \in \epsilon[p] \cap F} (d[p, q] \otimes \rho[q])$.

9. (Original) The method of claim 8, further comprising:

performing a depth-first search of the automaton A after removing the empty strings.

10. (Currently Amended) A method of producing an equivalent weighted automaton "B" with no ε-transitions for any input weighted automaton "A" having at least one ε-transition, the automaton "A" having a ~~set~~ <u>plurality</u> of states "p", and a ~~set~~ <u>plurality</u> of states "q", the method comprising:

<u>inputting a plurality of electrical signals representing the input weighted automaton A, the weighted automaton A further representing a plurality of hypotheses with associated weights;</u>

computing an ε-closure for each ~~state~~ <u>of the plurality of states</u> "p" of the input weighted automaton "A"; <u>and</u>

<u>producing a plurality of electrical signals representing the automaton "B" equivalent to automaton A without the ε-transitions, the producing comprising:</u>

modifying outgoing transitions of each ~~state~~ of the plurality of states "p" by:

removing each transition labeled with an empty string; and

adding to ~~each transition leaving state "p"~~ a plurality of outgoing transitions from the plurality of states "p" a non-empty-string transition, wherein each ~~state~~ of the plurality of states "q" is left with its weights pre-multiplied by an ε-distance from a corresponding one of the plurality of states ~~state~~ "p" to a respective one of the plurality of states "q" in the automaton "A" to produce the automaton "B" ~~equivalent to automaton A without the ε-transitions~~, the automaton "B" representing an improved version of the plurality of hypotheses.

11. (Currently Amended) The method of claim 10, further comprising:

removing inaccessible states of the automaton "A" using a depth-first search of the automaton "A".

12. (Currently Amended) The method of claim 11, wherein adding to the plurality of outgoing transitions from the plurality of states "p" a non-empty-string ~~transitions~~ transition further comprises leaving each of the plurality of states ~~state~~ "q" with weights $(d[p,q] \otimes \rho[q])$ to the transitions leaving corresponding ones of the plurality of states "p".

13. (Currently Amended) ~~A~~ <u>The</u> method of claim 10, wherein the ~~step of~~ computing <u>of</u> ~~an~~ <u>the</u> ε-closure for each ~~input state~~ <u>of the plurality of states "p"</u> of ~~an~~ <u>the</u> input automaton "A" further comprises:

removing all non-ε-transitions to produce an automaton A_ε;

decomposing <u>the automaton</u> A_ε into its strongly connected components; and

computing all-pairs shortest distances in each <u>of the strongly connected components</u> ~~component~~ visited in reverse topological order.

14. (Currently Amended) The method of claim 10, wherein the ~~step of~~ computing <u>of</u> the ε-closure for each ~~state~~ <u>of the plurality of states</u> "p" further comprises computing each of the ε-closures according to the following equation:

$$C[p] = \{(q,w) : q \in \varepsilon[p], d[p,q] = w \in K — \{\bar{O}\}\}.$$

15. (Currently Amended) The method of claim 14, wherein the ~~step of~~ modifying <u>the</u> outgoing transitions of each <u>of the plurality of states</u> ~~state~~ "p" further comprises modifying the outgoing transitions of each <u>of the plurality of states</u> ~~state~~ p according to the following procedure:

~~(1)~~ for each $p \in Q$

~~(2)~~ do $E[p] \leftarrow \{e \in E[p] : i[e] \neq \varepsilon\}$

~~(3)~~ for each $(q,w) \in C[p]$

~~(4)~~ do $E[p] \leftarrow E[p] \cup \{(p,a,w \otimes w',r) : (q, a, w', r) \in E[q], a \neq \varepsilon\}$

~~(5)~~ if $q \in F$

~~(6)~~ then if $p \notin F$

~~(7)~~ then $F \leftarrow F \cup \{p\}$

~~(8)~~ $\rho[p] \leftarrow p[p] \oplus (\omega \oplus \rho[q])$.

16. (Currently Amended) A method of producing an automaton B from an automaton A, the automaton B having no empty string transitions, the method comprising:

inputting a plurality of electrical signals representing the automaton A, the automaton A further representing a plurality of hypotheses with associated weights;

computing for each state p in the automaton A its ε-closure C[p] according to the following: $C[p] = \{(q,w) : q \in \varepsilon[p], d[p,q] = w \in K—\{\bar{O}\}\}$, where ε[p] represents states labeled with an empty string;

removing each transition labeled with an empty string; and

producing a plurality of electrical signals representing the automaton B, the automaton B being equivalent to the automaton A without ε-transitions, the producing comprising:

adding to each transition leaving the states ~~state~~ "p" a non-empty-string transition, wherein each state "q" in the automaton A is left with its weights pre-multiplied by an ε-distance from one of the states ~~state~~ "p" to

a respective one of the states "q" in the automaton "A" to produce the automaton "B" ~~equivalent to automaton A without the ε-transitions~~.

17. (Currently Amended) The method of claim 16, wherein the adding the non-empty-string transition to each of the transitions leaving the states "p" ~~strings to E[p]~~ is performed according to the following code:

~~(1)~~ for each $p \in Q$

~~(2)~~ do $E[p] \leftarrow \{e \in E[p] : i[e] \neq \varepsilon\}$

~~(3)~~ for each $(q,w) \in C[p]$

~~(4)~~ do $E[p] \leftarrow E[p] \cup \{(p,a,w \otimes w',r) : (q, a, w', r) \in E[q], a \neq \varepsilon\}$

~~(5)~~ if $q \in F$

~~(6)~~ then if $p \notin F$

~~(7)~~ then $F \leftarrow F \cup \{p\}$

~~(8)~~ $\rho[p] \leftarrow p[p] \oplus (\omega \oplus \rho[q])$, where $E[p]$ is plurality of outgoing transitions from the states "p".

18. (Currently Amended) The method of claim 10, further comprising modifying a plurality of outgoing transitions from the states "p", E[p], according to the following procedure:

~~(1)~~ for each $p \in Q$
~~(2)~~ do $E[p] \leftarrow \{e \in E[p] : i[e] \neq \varepsilon\}$

for each $(q,w) \in C[p]$
  do $E[p] \leftarrow E[p] \cup \{(p,a,w \otimes w',r) : (q, a, w', r) \in E[q], a \neq \varepsilon\}$
    if $q \in F$
      then if $p \notin F$
        then F $\leftarrow F \cup \{p\}$
          $\rho[p] \leftarrow p[p] \oplus (\omega \oplus \rho[q])$.

19. (Currently Amended) A method of producing an equivalent weighted automaton "B" with no ε-transitions for any input weighted automaton "A" having a set of transitions E, wherein each transition "e" in the set of transitions has an input label i[e], at least one transition being an ε-transition, a set of states P, each state in the set of states P is denoted as "p", and a set of states Q, each state in the set of states Q denoted as "q", a weight w[e] for each transition "e", and E[p] the transitions leaving each state "p" and E[q] being the transitions leaving state "q", an ε-closure for a state being defined as C[p], and where ε[p] represents a set of states reachable from state "p" via a path labeled with an ε-transition, the method comprising:

<u>inputting a plurality of electrical signals representing the weighted automaton A, the weighted automaton A further representing a plurality of hypotheses with associated weights;</u>

computing an ε-closure C[p] for each state "p" of the input weighted automaton "A";

removing each ε-transition of the weighted automaton A to produce an automaton A_ε; and

producing a plurality of electrical signals representing the automaton B, the automaton B being equivalent to the automaton A without ε-transitions, the producing further comprising:

adding to E[p] non-empty-string transitions leaving each state “q” from the set of states reachable from “p” via a path labeled with an ~~ε-transitions~~ ε-transition, wherein each state “q” is left with its weights pre-multiplied by an ε-distance from state “p” to “q” in the automaton “A” to produce the automaton “B” ~~equivalent to automaton A without ε-transitions~~.

20. (Currently Amended) A method of producing an equivalent weighted automaton “B” with no ε-transitions for any input weighted automaton “A” having a set of transitions “e”, at least one of which is an ε-transition, a set of states “p”, and a set of states “q”, the method comprising:

inputting a plurality of electrical signals representing the weighted automaton A, the weighted automaton A further representing a plurality of hypotheses with associated weights; and

producing a plurality of electrical signals representing the automaton B with no ε-transitions, the producing comprising:

computing an ε-closure C[p] for each state "p" of the input weighted automaton "A";

for each of the states ~~state~~ "p", determining ~~the~~ non-ε-transitions from ~~state~~ the states "p";

for each of the states ~~state~~ "q" having a weight "w" within the computed ε-closure C[p]:

adding to outgoing transitions from the states "p", E[p], the non-ε-transitions leaving each of the states ~~state~~ "q"; and

if ~~state~~ one of the states "q" is part of a set of final states F, and if a corresponding one of the states ~~state~~ "p" is not part of the set of final states F:

defining the corresponding one of the states ~~state~~ "p" as included within the set of final states "F" and ~~the~~ a final weight ρ[p] as pre-⊗-multiplied by w, the ε-distance from state "p" to state "q" in the automaton A to produce the automaton B.

21. (Currently Amended) A method of removing string terms "a" from an automaton A having a set of states "p", a set of states "q", and a set of outgoing transitions from the set of states "p", E[p], the method comprising:

inputting a plurality of electrical signals representing the automaton A, the automaton A further representing a plurality of hypotheses with associated weights;

producing a plurality of electrical signals representing an automaton B from the automaton A, the producing comprising;

computing an a-closure for each state "p" of the automaton A; and modifying E[p] by:

removing each transition labeled with a string term "a"; and

adding to E[p] a non-"a"-string transition, wherein each state "q" is left with its weights pre-⊗-multiplied by an a-distance from state "p" to a state "q" in the automaton A to produce the automaton B.

22. (Original) The method of claim 21, further comprising:

removing inaccessible states using a depth-first search of the automaton A.

23. (Currently Amended) The method of claim 21, wherein adding to E[p] a non-"a"-string ~~transitions~~ transition further comprises leaving ~~q~~ the state "q" with weights (d[p,q] ⊗ ρ[q]) to E[p].

24. (Currently Amended) The method of claim 21, wherein the ~~step of~~ computing of an a-closure for each ~~input~~ state "p" of an input automaton A further comprises:

removing all transitions not labeled with a string "a" from automaton A to produce an automaton A_a;

decomposing A_a into its strongly connected components; and

computing all-pairs shortest distances in each <u>of the strongly connected components</u> ~~component~~ visited in reverse topological order.

25. (Currently Amended) The method of claim 21, wherein the ~~step of~~ computing <u>of</u> an a-closure for each ~~input~~ state <u>"p"</u> of an input automaton A further comprises:

decomposing A_a into its strongly connected components;

performing a single-source shortest-distance algorithm according to the following pseudo code:

for each $p \in Q$

do $d[p] \leftarrow r[p] \leftarrow \bar{0}$

$d[s] \leftarrow r[s] \leftarrow \bar{1}$

$S \leftarrow \{s\}$

while $S \neq 0$

do $q \leftarrow$ head $[S]$

DEQUEUE (S)

$r \leftarrow r[q]$

$r[q] \leftarrow \bar{0}$

for each $e \in E[q]$

do if $d[n[e]] \neq d[n[e]] \oplus (r \otimes w[e])$

then $d[n[e]] \leftarrow d[n[e]] \oplus (r \otimes w[e])$

$r[n[e]] \leftarrow r[n[e]] \oplus (r \otimes w[e])$

if $n[e] \notin S$

then ENQUEUE (S, n[e])

$d[s] \leftarrow \bar{1}$.

26. (Currently Amended) The method of claim 21, wherein the ~~step of~~ computing of the a-closure for each state "p" further comprises computing each of the a-closures according to the following equation:

$$C[p] = \{(q,w) : q \in a[p], d[p,q] = w \in K - \{\bar{0}\}\}.$$

27. (Currently Amended) The method of claim 26, wherein the ~~step of~~ modifying of ~~outgoing transitions of each state "p"~~ E[p] further comprises modifying the outgoing transitions of each state ~~p~~ "p" according to the following procedure:

~~(1)~~ for each $p \in Q$

~~(2)~~ do $E[p] \leftarrow \{e \in E[p] : i[e] \neq a\}$

~~(3)~~ for each $(q,w) \in C[p]$

~~(4)~~ do $E[p] \leftarrow E[p] \cup \{(p,a,w \otimes w',r) : (q, a, w', r) \in E[q], a \neq a\}$

~~(5)~~ if $q \in F$

~~(6)~~ then if $p \notin F$

~~(7)~~ then F $\leftarrow F \cup \{p\}$

~~(8)~~ $\rho[p] \leftarrow p[p] \oplus (\omega \oplus \rho[q])$.

28. (Currently Amended) The method of claim 27, wherein a state is a final state if some state "q" within a set of states reachable from "p" via a path labeled with an empty string is final and ~~the~~ a final weight is then:

$$\rho[p] = \bigoplus_{q \in e[p] \cap F} (d[p,q] \otimes \rho[q])$$

29. (Original) The method of claim 28, further comprising:

performing a depth-first search of the automaton A after removing the "a" strings.

30. (Currently Amended) A method of removing empty string terms from a transducer A having a set of states "p", a set of states "q", and a set of outgoing transitions from the set of states "p", E[p], the method comprising:

inputting a plurality of electrical signals representing the transducer A; and

generating a plurality of electrical signals representing a modified transducer A by:

computing an ε-closure for each ~~state~~ of the states "p" of the transducer A;

modifying E[p] by:

removing each transition labeled with an empty string; ~~and~~

adding to the E[p] a non-empty-string transition, wherein each ~~state~~ of the states "q" is left with its weights pre-multiplied by an ε-distance from ~~state~~ a corresponding one of the states "p" to a respective one of the states ~~state~~ "q" in the transducer A to generate the modified transducer A.

31. (Original) The method of claim 30, further comprising:

removing inaccessible states using a depth-first search of the transducer A.

32. (Currently Amended) The method of claim 30, wherein adding to E[p] non-empty-string transitions further comprises leaving the states q with weights $(d[p,q] \otimes \rho[q])$ to E[p].

33. (Currently Amended) The method of claim 30, wherein the ~~step of~~ computing of the ε-closure for each ~~input state~~ of the states "p" of ~~an input~~ the transducer A further comprises:

removing all transitions not labeled with an empty string from transducer A to produce a transducer A_ε;

decomposing A_ε into its strongly connected components; and

computing all-pairs shortest distances in each ~~component~~ of the strongly connected components visited in reverse topological order.

34. (Currently Amended) The method of claim 30, wherein the ~~step of~~ computing of the ε-closure for each ~~input state of an input~~ of the states "p" of the transducer A further comprises:

decomposing A_ε into its strongly connected components;

performing a single-source shortest-distance algorithm according to the following pseudo code:

for each $p \in Q$

do $d[p] \leftarrow r[p] \leftarrow \bar{0}$

$d[s] \leftarrow r[s] \leftarrow \bar{1}$

$S \leftarrow \{s\}$

while $S \neq 0$

do $q \leftarrow$ head $[S]$

DEQUEUE (S)

$r \leftarrow r[q]$

$r[q] \leftarrow \bar{0}$

for each $e \in E[q]$

do if $d[n[e]] \neq d[n[e]] \oplus (r \otimes w[e])$

then $d[n[e]] \leftarrow d[n[e]] \oplus (r \otimes w[e])$

$r[n[e]] \leftarrow r[n[e]] \oplus (r \otimes w[e])$

if $n[e] \notin S$

then ENQUEUE $(S, n[e])$

$d[s] \leftarrow \bar{1}$.

35. (Currently Amended) The method of claim 30, wherein the ~~step of~~ computing <u>of</u> the ε-closure for each ~~state~~ <u>of the states</u> "p" further comprises computing each the ε-closure according to the following equation:

$$C[p] = \{(q,w) : q \in \varepsilon[p], d[p,q] = w \in K - \{\bar{0}\}\}.$$

36. (Currently Amended) The method of claim 35, wherein the ~~step of~~ modifying <u>of the</u> outgoing transitions of each ~~state~~ <u>of the states</u> "p" further comprises modifying the outgoing transitions of each ~~state p~~ <u>of the states "p"</u> according to the following procedure:

~~(1)~~ for each $p \in Q$

~~(2)~~ do $E[p] \leftarrow \{e \in E[p] : i[e] \neq \varepsilon\}$

~~(3)~~ for each $(q,w) \in C[p]$

~~(4)~~ do $E[p] \leftarrow E[p] \cup \{(p,a,w \otimes w',r) : (q,a,w',r) \in E[q], a \neq \varepsilon\}$

~~(5)~~ if $q \in F$

~~(6)~~ then if $p \notin F$

~~(7)~~ then F $\leftarrow F \cup \{p\}$

~~(8)~~ $\rho[p] \leftarrow p[p] \oplus (\omega \oplus \rho[q])$.

37. (Currently Amended) The method of claim 36, wherein a state is a final state if some state "q" within a set of states reachable from a corresponding state "p" via a path labeled with an empty string is final and the final weight is then:

$$\rho[p] = \bigoplus_{q \in e[p] \cap F} (d[p,q] \otimes \rho[q])$$

38. (Original) The method of claim 37, further comprising:

performing a depth-first search of the transducer A after removing the empty strings.